

Mr Thavarajah Shanthakumaran

JULIAN TERRACE, PORT TALBOT

Foundation Works Risk Assessment

12603/JJ/23/FWRA

CLIENT: Mr Thavarajah Shanthakumaran

PROJECT: Julian Terrace, Port Talbot

TITLE: Foundation Works Risk Assessment

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1.0 INTRODUCTION

Mr Thavarajah Shanthakumaran is proposing to redevelop a site at Julian Terrace in Port Talbot for a mixed commercial and residential end-use.

Vale Consultancy are the appointed Consulting Civil and Structural Engineers for the scheme.

The proposed development comprises the construction of a mixed commercial and residential unit. The building will be designed with two shop units on the ground floor with residential flats above. Parking areas will also be provided as part of the development.

Due to the presence of made ground and soft clay soils underlying the site, the use of conventional shallow foundations is not considered feasible due to the potential for unacceptable total and differential settlements. It is therefore recommended that a piled foundation solution is utilised for the proposed building.

It is understood that it is proposed to utilise a driven pile foundation solution.

With reference to established guidance (References [1] and [2]), a general assessment of the applicability of a driven piling method with appropriate mitigation measures against identified potential pollution scenarios is given in Table 1 below. A desk study and intrusive site investigation (References [3] and [4]) has been undertaken to establish the underlying ground conditions.

This assessment is presented to determine the extent and type of mitigation necessary to undertake the construction works comprising driven piles (displacement piles).

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2.0 GEO-ENVIRONMENTAL BACKGROUND

Based on a review of the existing desk study and site investigation data (References [3] and [4]), the geo-environmental background of the site has been summarised below.

Published Geology and Hydrogeology

The geology underlying the site area can be differentiated into the following generalised strata for the purposes of this assessment:

- Made Ground Deposits
- Superficial Tidal Flat Deposits
- South Wales Middle Coal Measures (mudstones/siltstones, with seatearths and minor sandstones)

Natural Resources Wales classify the superficial deposits beneath the site as a 'Secondary Aquifer-Undifferentiated'.

Natural Resources Wales classify the bedrock beneath the site as a Secondary 'A' Aquifer.

The site is not located in a groundwater Source Protection Zone (SPZ).

There are no recorded groundwater abstractions within 1km of the site.

The nearest surface water feature to be the Rive Afan located 335m to the southeast of the site.

Ground Conditions

The ground conditions recorded beneath the site during the intrusive site investigation works (Reference [3] and [4]), generally comprised of a variable thickness of made ground (up to approximately 1.0m thick), over thick superficial soils comprising of Tidal Flat Deposits.

The made ground typically comprised a layer of granular soils over cohesive deposits with variable quantities of man-made constituents including brick and clinker. The base of the made ground deposits was recorded to vary between approximately 0.6m and 1.0m bgl.

Superficial soils comprising Tidal Flat Deposits underlie the made ground beneath the site. These soils typically comprise soft rapidly becoming very soft (typically from depths ranging between 1.1m and 1.3m bgl) blue grey clay. The clay soils are underlain by a loose sand deposits which in-turn overlie medium dense becoming dense sands and gravels at depth.

2.0 GEO-ENVIRONMENTAL BACKGROUND (CONTINUED)

Groundwater was encountered at a depth of approximately 2.8m bgl (standing at a depth of approximately 1.4m bgl).

Soil Contamination

Contamination testing on samples of made ground was undertaken as part of the intrusive site investigation works (Reference [3]). The results were screening against published soil screening values for a proposed residential end use.

The results indicated that most of the analysed chemical elements and compounds are present at concentrations below the appropriate thresholds. However, the initial screening did record some localised elevated concentrations of arsenic, beryllium and dibenzo(ah)anthracene.

Elevated concentrations of arsenic were detected within two tested samples of made ground. The recorded concentrations of 53mg/kg and 44mg/kg respectively slightly exceed the guideline concentration of 40mg/kg (S4UL).

A single elevated concentration of beryllium was detected within a tested sample of made ground. The recorded concentration of 2.5mg/kg exceeds the guideline concentration of 1.7mg/kg (S4UL).

A single elevated concentration of dibenzo(ah)anthracene was detected within a tested sample of made ground. The recorded concentration of 0.42mg/kg exceeds the guideline concentration of 0.3mg/kg (S4UL).

Asbestos was not detected in any of the tested soil samples.

No elevated concentrations of petroleum hydrocarbons were recorded within the tested sample of made ground.

The identified contamination is not considered significant and is not considered to pose a significant risk to controlled waters.

Ground Gases

Ground gas monitoring has been undertaken at the site. The results show a maximum methane concentration of <0.1% and a maximum carbon dioxide concentration of 0.7%. A maximum gas flow rate of <0.3l/hr was measured during the gas monitoring (Reference [4]).

3.0 FOUNDATION WORKS

Due to the presence of made ground and soft clay soils underlying the site, the use of conventional shallow foundations is not considered feasible due to the potential for unacceptable total and differential settlements. It is therefore recommended that a piled foundation solution is utilised for the proposed building.

At this stage, all piles are proposed to comprise driven pre-cast concrete piles (displacement piles) taken down to an appropriate set within competent superficial deposits underlying the made ground and soft clay soils.

The following table summarises the potential contamination scenarios that may arise from the proposed foundation solution and the required mitigation measures.

Impact Key:

- A:** Pollution scenario not likely to be an issue if using this method provided workmanship and QA/QC measures are appropriate.
- B:** Subject to appropriate workmanship, mitigation, and QA/QC measures.
- C:** This method may be considered acceptable, depending on specific type used and subject to appropriate workmanship, mitigation, and QA/QC measures. However, a more suitable piling or ground improvement method may be available.
- D:** This method should normally be avoided on sites where this pollution scenario is likely to be an issue.

Table 1: Summary of Potential Impacts Due to Driven Piling and Mitigation Measures			
Pollution Scenario	Pollution Scenario Status	Justification / Mitigation Measures	Impact
1. Creation of preferential pathways, through a low permeability clay layer (an aquitard), to allow potential contamination of an underlying aquifer	Potentially Active	Single building / minimal number of piles. The ground conditions comprise made ground over Tidal Flat deposits over Coal Measures bedrock. When driving displacement piles the soil surrounding the pile is densified and high stresses are induced in the surrounding ground. These stresses increase with the size of pile and magnitude of displacement. In most soils these stresses will tend to force the soil to close up around the pile shaft, which means that the development of preferential flow paths around the outside of the pile is, in general, unlikely. It is considered that provided the aquitard layer is of reasonable thickness (twice pile diameter) and the piles driven through have a cross section without re-entrant angles (H section/I section), the likelihood of creating preferential pathways for downward migration of leachate is very low.	A

3.0 FOUNDATION WORKS (CONTINUED)

Table 1: Summary of Potential Impacts Due to Driven Piling and Mitigation Measures (CONTINUED)			
Pollution Scenario	Pollution Scenario Status	Justification / Mitigation Measures	Impact
2. Creation of preferential pathways, through a low permeability surface layer, to allow upward migration of landfill gas, soil gas or contaminant vapours to the surface	Potentially Active	The ground gas monitoring undertaken on site has not identified any ground gases that require specific ground gas mitigations measures.	A
3. Direct contact of site workers and others with contaminated soil arisings which have been brought to surface	Potentially Active	No arisings with displacement driven systems	A
4. Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials (where the secondary effects are to increase the potential for contaminant migration)	Potentially Active	Low levels of contamination. Concrete to be designed to appropriate sulphate class	B
5. The driving of solid contaminants down into an aquifer during pile driving	Potentially Active	Single building / minimal number of piles. Contact area is small and unlikely to push any significant materials ahead of the pile. Furthermore, no significant contamination levels recorded during intrusive site investigation works that could pose a risk to groundwater quality.	B
6. Contamination of groundwater and, subsequently, surface waters by concrete, cement paste or grout	Potentially Active	Single building / minimal number of piles. Use of pre-cast concrete piles. In situ concrete only for beams and pile caps. The site is not underlain by a Principal Aquifer or a SPZ.	A

The above risk assessment should be reviewed and amended if the proposed piling methodology and/or pile type are changed from driven pre-cast concrete piles/displacement piles.

4.0 MITIGATION OPTIONS

The primary mitigation measures are:

1. Displacement piles, pre-cast driven concrete piles or driven steel tube piles, to be adopted.
2. A ratio >2:1 aquitard: pile diameter, see Pollution Scenario 1 above.
3. Neither method will generate arisings, see Pollution Scenario 3 above.
4. A small cross section relative to depth will not push any significant materials ahead of the pile, see Pollution Scenario 5 above.
5. Appropriate measures are recommended for works involving the asbestos contaminated made ground materials which are known to be present beneath the site. See previous Site Investigation Report (Reference [3]).
6. Concrete to be designed to appropriate sulphate class.
7. No ground gas identified.

5.0 REFERENCES

- [1] National Groundwater & Contaminated Land Centre (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention Report NC/99/73.
- [2] Environment Agency Document – Piling in layered ground: Risks to groundwater and archaeology.
- [3] Intégral Géotechnique Site Investigation Report No. 12603/JJ/20/SI dated March 2020.
- [4] Intégral Géotechnique Shell and Auger Borehole Ground Investigation Report No. 12603/JJ dated 07 February 2023.

FIGURES

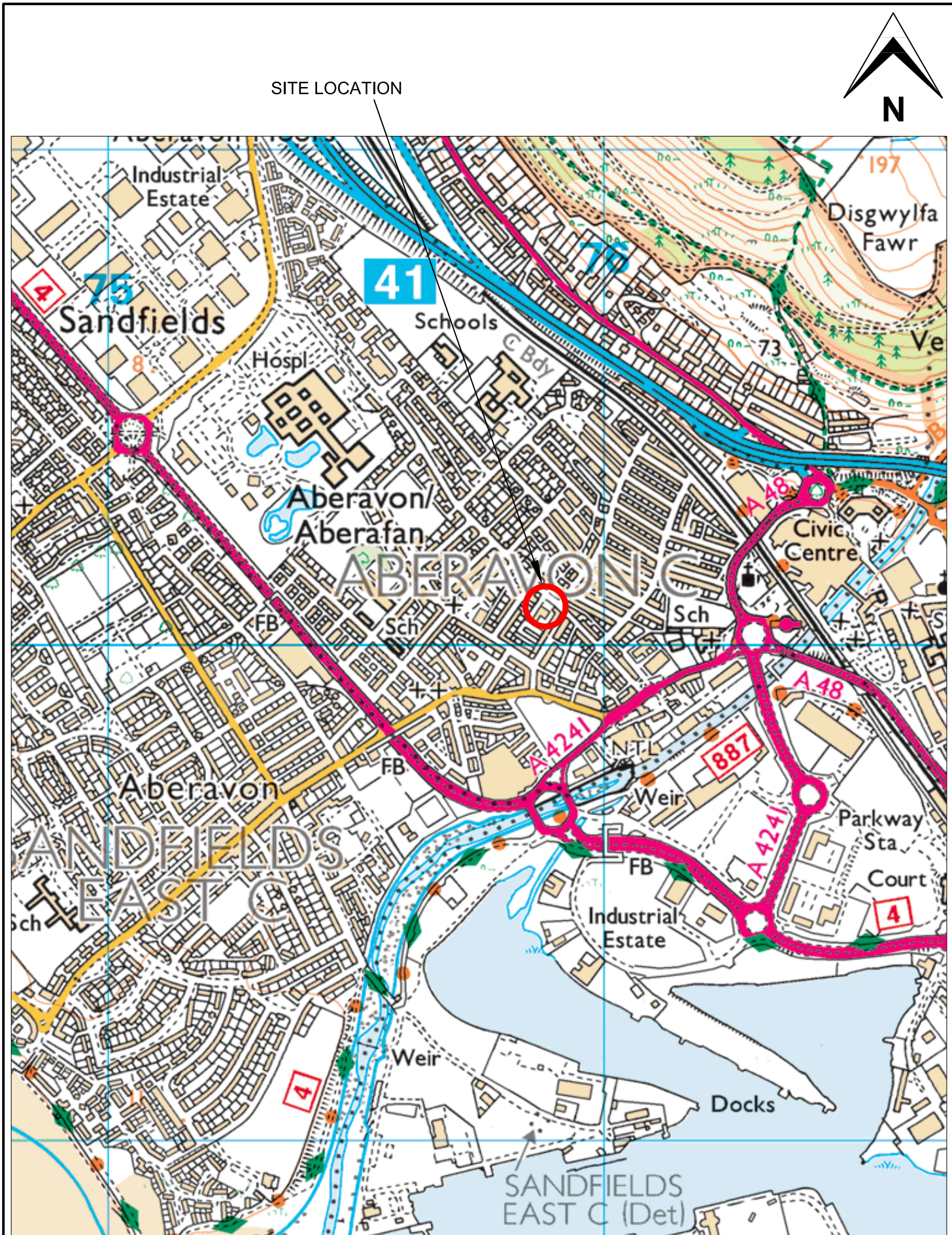


Figure 1: Site Location

Project: Julian Terrace, Port Talbot

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Client: Mr Thavarajah Shanthakumaran

Scale: 1:10,000 at A4

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